We Claims

1. A method for producing water-insoluble polysaccharides, comprising the steps of:

(a) preparing a hydroxyl-containing polysaccharide solution;

(b) adjusting a moderate pH range of polysaccharide containing hydroxyl groups solution;

(c) cross-linking the hydroxyl-containing polysaccharide solution with the poly-functional epoxy compound and producing different shapes of the water-insoluble polysaccharide by taking shape procedure.

2. The method of claim 1 wherein said process of cross-linking is performed prior to the taking shape procedure.

3. The method of claim 1 wherein said process of taking shape procedure is preformed prior to the cross-linking reaction.

4. The method of claim 1 wherein said hydroxyl-containing polysaccharide is chosen from the group consisting of hyaluronic acid, carboxylmethyl cellulose, starch, alginate, chondroitin-4-sulfate, chondroitin-6-sulfate, xanthane gum, chitosan, pectin, agar, carrageenan and guar gum.

5. The method of claim 1 wherein said step (a) comprising an aqueous solution of hydroxyl-containing polysaccharide has a dry solids content of from 0.2 to 10% by weight.

6. The method of claim 1 wherein said step (b) is carried out at a pH of 2 to 11.

7. The method of claim 6 wherein said method the preferred pH for carrying out the reaction is one of 2.5 to 7.5 and 9 to 11.

8. The method of claim 1 wherein said poly-functional epoxy compound is chosen from the group consisting of 1,4-butanediol diglycidyl ether (BDDE), ethylene glycol diglycidyl ether (EGDGE), 1,6-hexanediol diglycigyl ether, polyethylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, polytetramethylene glycol digylcidyl ether, neopentyl glycol digylcidyl ether, polyglycerol polyglycidyl ether,

diglycerol polyglycidyl ether, glycerol polyglycidyl ether, tri-methylolpropane polyglycidyl ether, pentaerythritol polyglycidyl ether and sorbitol polyglycidyl ether.

9. The method of claim 1 wherein the molar equivalent ratio of said polyfunctional epoxy compound to said hydroxyl-containing polysaccharide is in a range of between 0.1 and 8.0.

10. The method of claim 9 wherein the optimal molar equivalent ratio of said poly-functional epoxy compound to said hydroxyl-containing polysaccharide is 0.2 to 6.0.

11. The method of claim 1 wherein said step (c) the cross-linking reaction is carried out at 10℃ to 60℃ for 10 min to 12 hours.

12. The method of claim 1 wherein said step (c) the cross-linked polysaccharide solution is cast into a mold and allows to dry to yield a film of water-insoluble polysaccharide.

13. The method of claim 1 wherein said step (c) the cross-linked polysaccharide solution is cast into a mold and allows to freeze-dry to yield a porosity of water-insoluble polysaccharide.

14. The method of claim 1 wherein said step (c) the cross-linked polysaccharide is intermittent squeezed into the organic solvent of coagulant and allows yielding a sphere of water-insoluble polysaccharide.

15. The method of claim 12 to 14 wherein said the film, porosity and sphere of water-insoluble polysaccharides may be used as various medical and cosmetic uses after washing with water/organic solution, distilled water and drying under vacuum.

16. The method of claim 12 wherein the material of mold can be made up with the ceramic, metal or polymer.

17. The method of claim 12 wherein said the preferred temperature of drying is between 25℃ to 70℃.

18. The method of claim 13 wherein said the porosity of water-insoluble polysaccharide is in the form of a pore morphology with the inter connective structure.

19. The method of claim 14 wherein said the cross-linked polysaccharide is precipitated from the mixed solution under stirring condition and allows to produce a powder or sheet of water-insoluble polysaccharide by filtration.

20. The method of claim 15 wherein said the cross-linked polysaccharide is continual pressed into the coagulant organic solvent by a squeezer apparatus, and allows to produce water-insoluble polysaccharide fiber of 50 um-1 mm thickness.

21. The method of claim 14 wherein said the diameter of sphere is between 50 um and 1 mm.

22. The method of claim 14 wherein said coagulant solution comprises water and organic solvent.

23. The method of claim 22 wherein the weight fraction of said organic solvent is between 60% and 100%.

24. The method of claim 22 wherein said organic solvent is chosen from the group consisting of 1,4-dioxane, chloroform, methylene chloride, N, N-dimethylformamide (DMF), N, N-dimethylacetamide (DMAc), ethyl acetate, acetone, methyl ethyl ketone (MEK), methanol, ethanol, propanol, isopropanol and butanol.

25. The method of claim 14 wherein said method is carried out at a temperature of 5℃to 60℃.

26. The method of claim 15 wherein said organic solvent is chosen from the group consisting of acetone, methyl ethyl ketone (MEK), methanol, ethanol, propanol, isopropanol, butanol and the mixture of each organic solvent.

27. The method of claim 15 wherein the weight fraction of said organic solvent is between 50% and 100%.

28. The method of claim 26 wherein the ketone and alcohol can be mixed with any ratio.

29. The method of claim 15 wherein said method the temperature of water/organic solution is between 15℃and 50℃.

30. The method of claim 15 wherein said method the preferable temperature

of the distilled water is between 25℃ and 50℃.

31. The method of claim 15 wherein said method the different shapes of water-insoluble polysaccharides are further dried by hot air drying, radiation heating drying or vacuum drying.

32. The method of claim 31 wherein the preferable temperature of dryer is below 60℃.